Dust in submillimeter galaxies

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Current Problems in Extragalactic Dust
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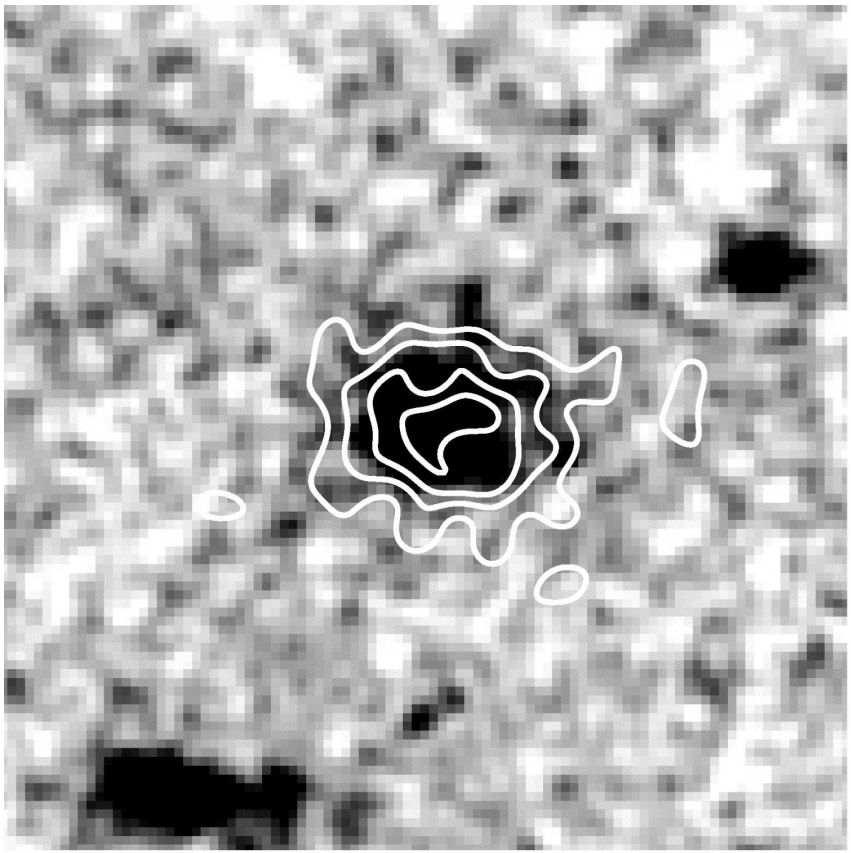
Outline

1. Submillimeter Galaxies
2. Method: Spectral Energy Distribution (SED) Fitting
3. Results
   - Properties of SMGs
   - Dust heating mechanism
   - Open questions

Submillimeter Galaxies (SMGs)



(Chapman et al., ApJ, 2004, 611, 732)

- Selected at submm (850 μm)
- $z = 1.7 - 2.8$ (Chapman et al., 2005, ApJ, 622, 772)
- Luminous, massive, dusty galaxies
- Studies based on small ($\lesssim 20$) samples, photometric redshifts, limited wavelength coverage

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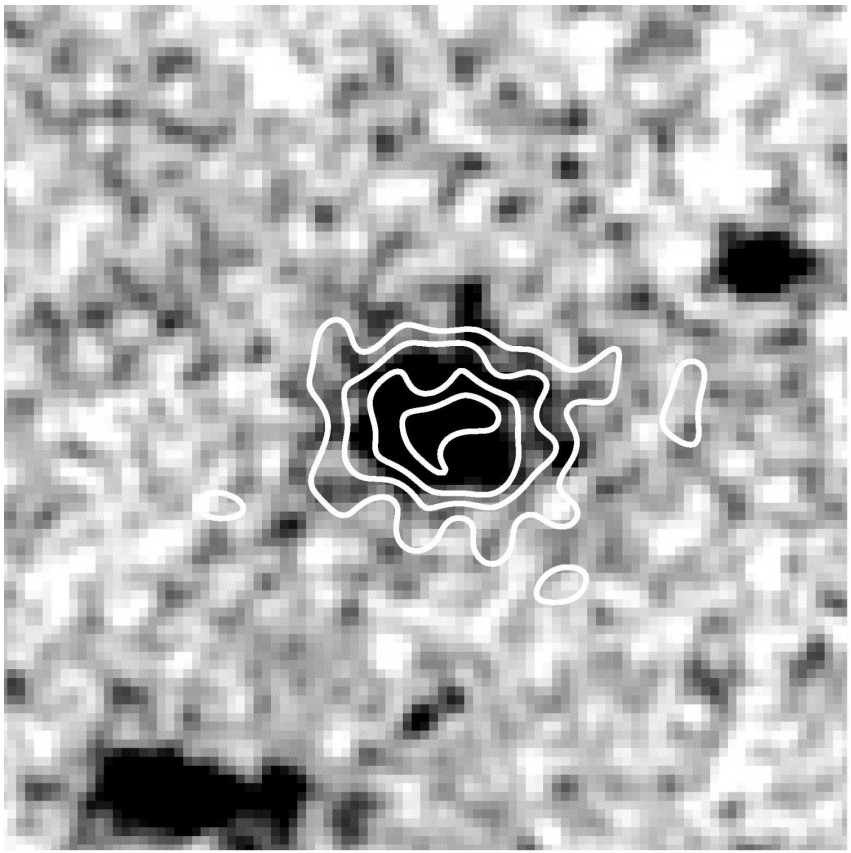

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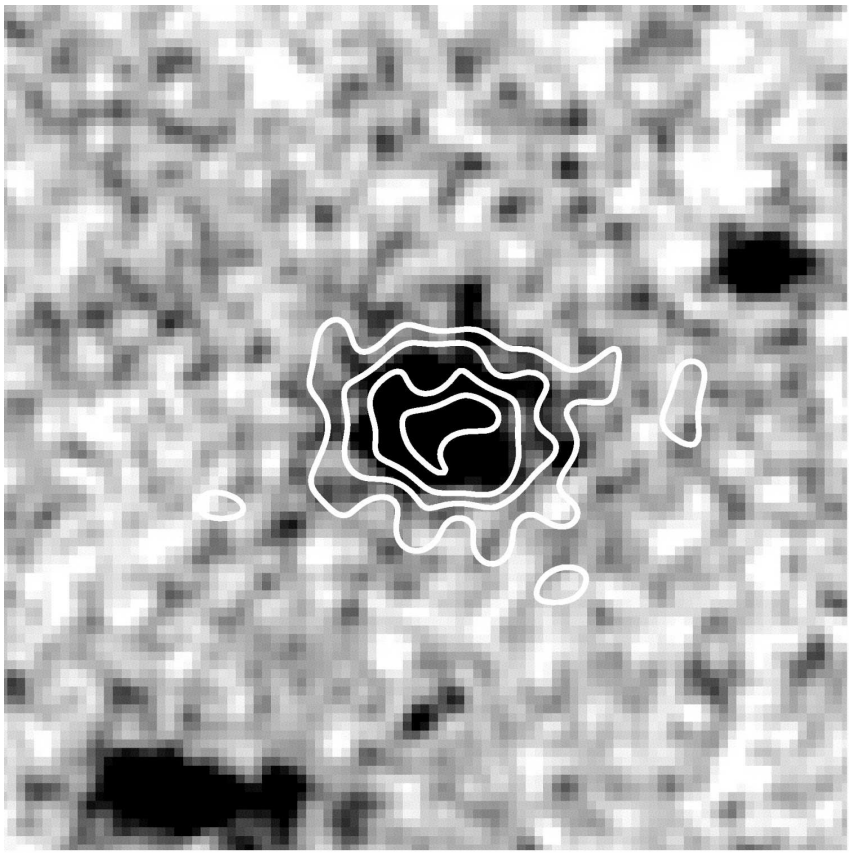

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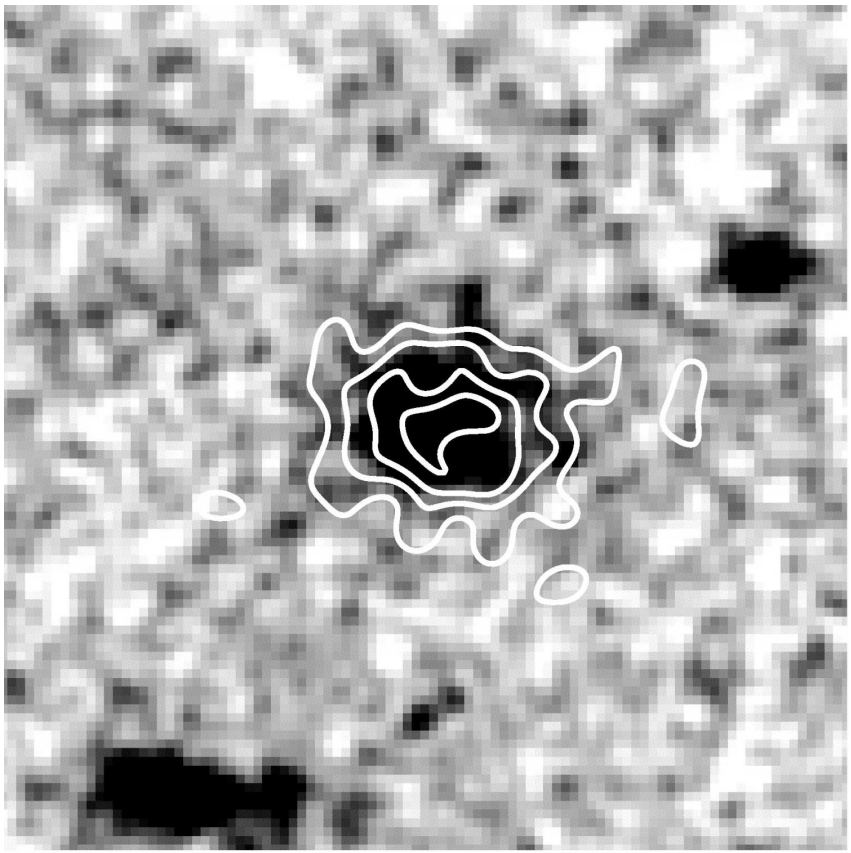

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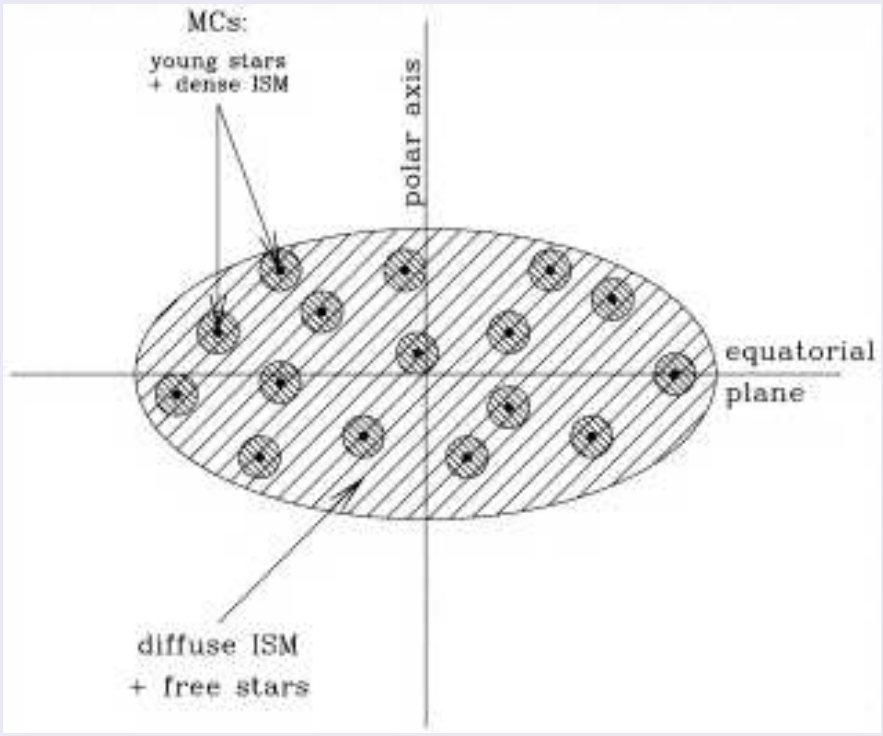
GRASIL (Silva et al. 1998, ApJ, 509, 103)

The Model

- Self-consistent and evolutionary model of galaxy SED based on radiative transfer
- Stellar population born in MCs + dust
- GRAphite & SILicate or GRAnato & SILva

Galaxy Geometry



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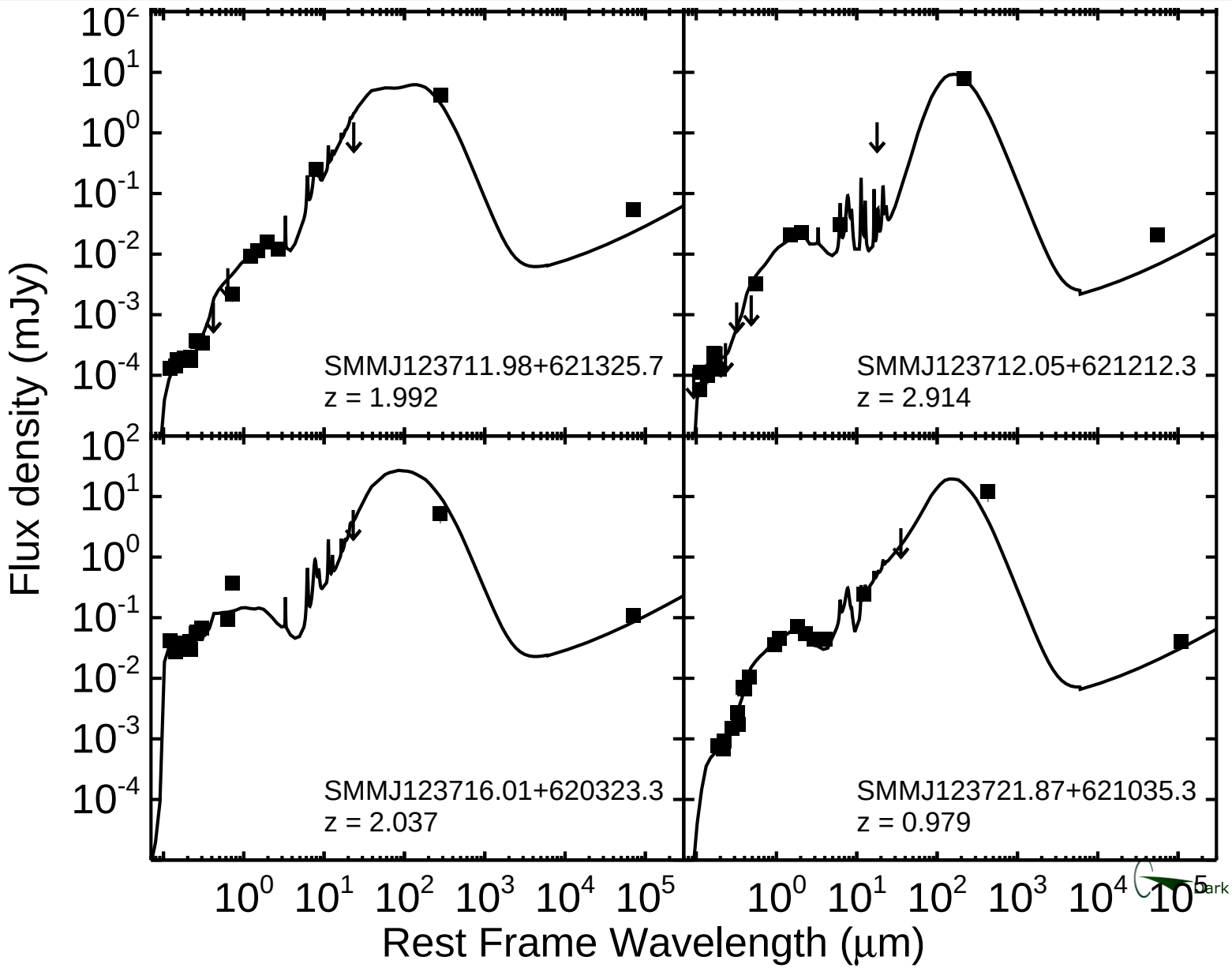
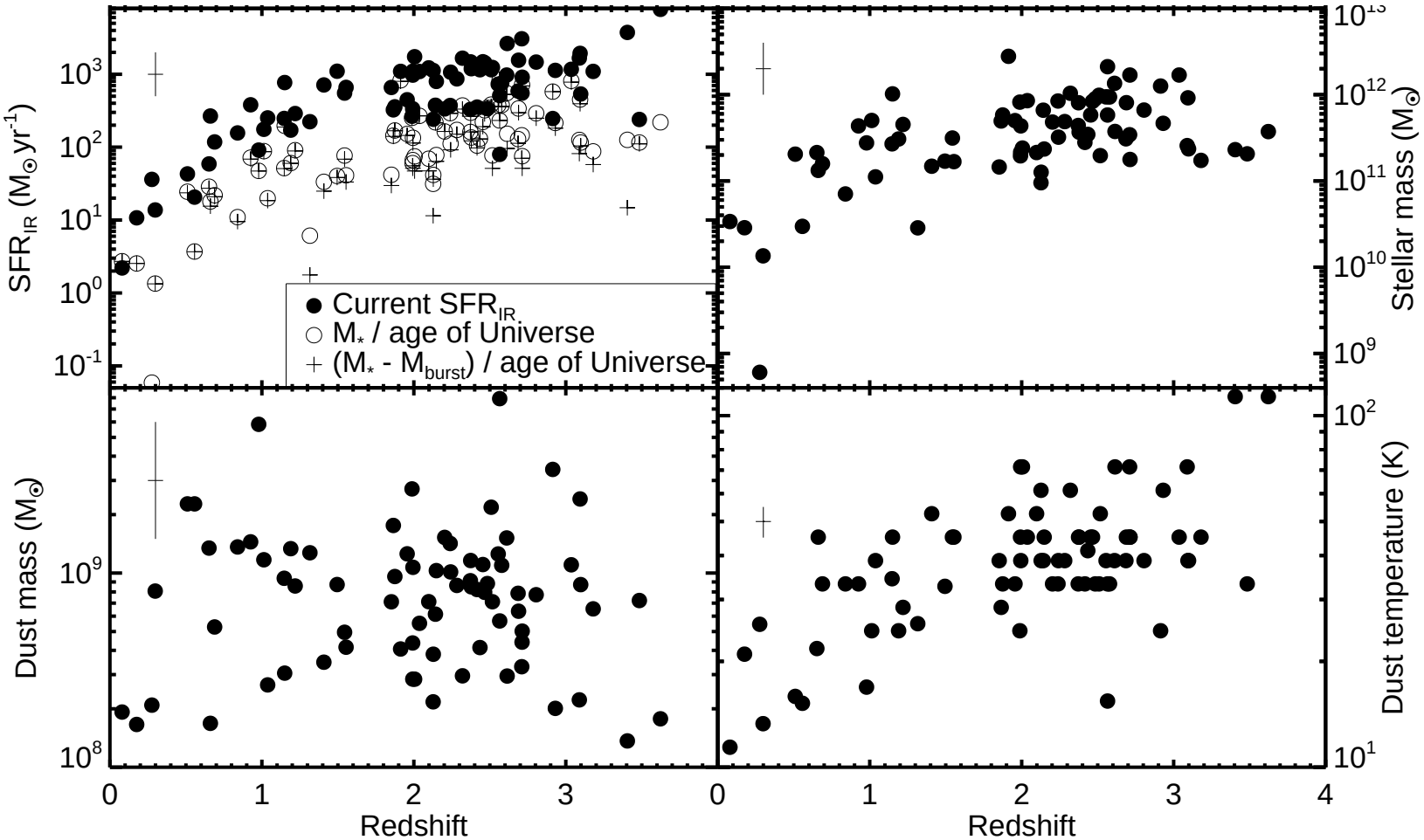
Spectral Energy Distribution Fitting of SMGs



Properties of SMGs



$M_{H_2}/M_d = 54^{+14}_{-11}$ (Kovács et al., ApJ, 2006, 650, 592)

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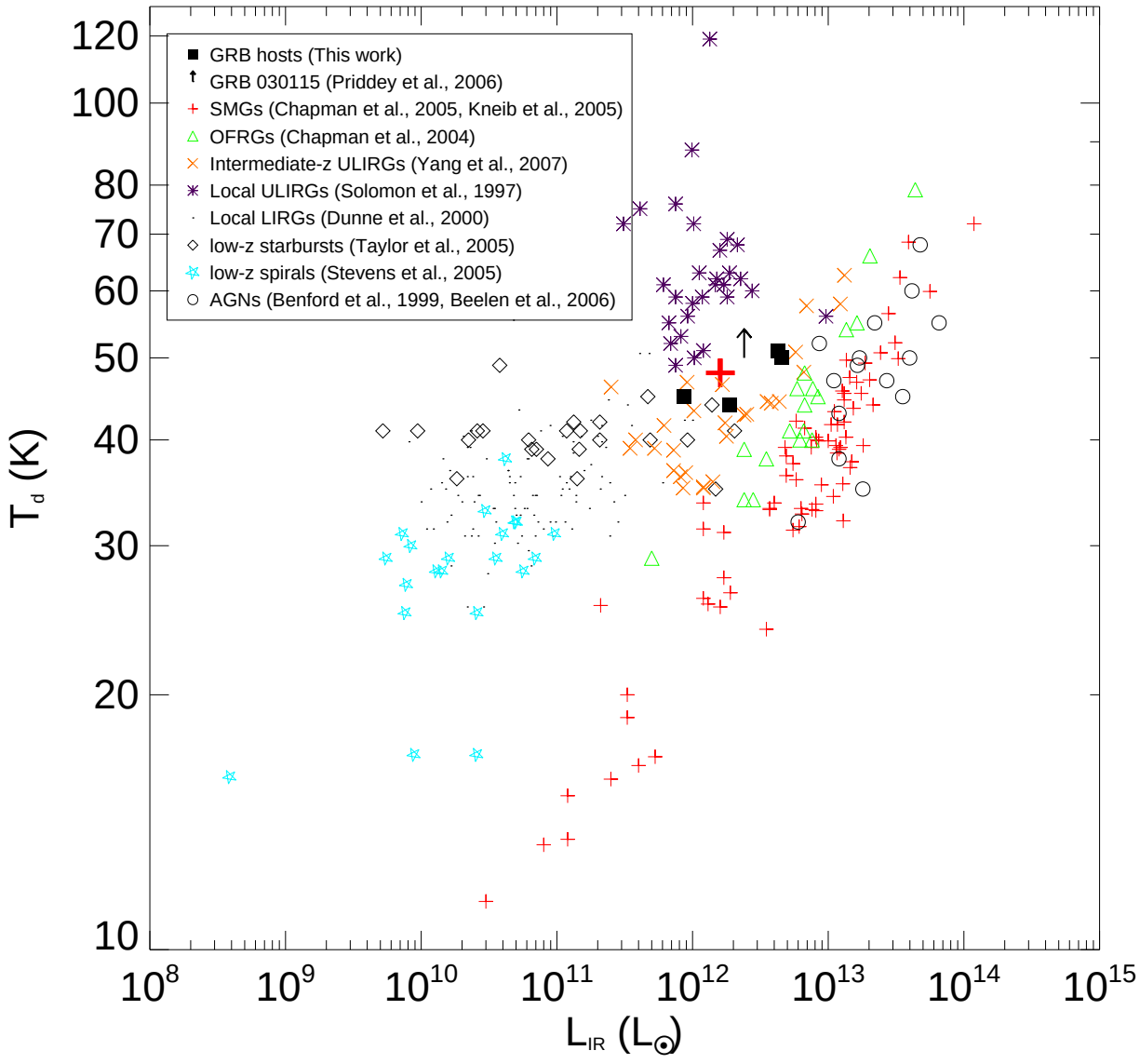
Temperature vs. luminosity (Michałowski et al., ApJ, 2008, 672, 817)



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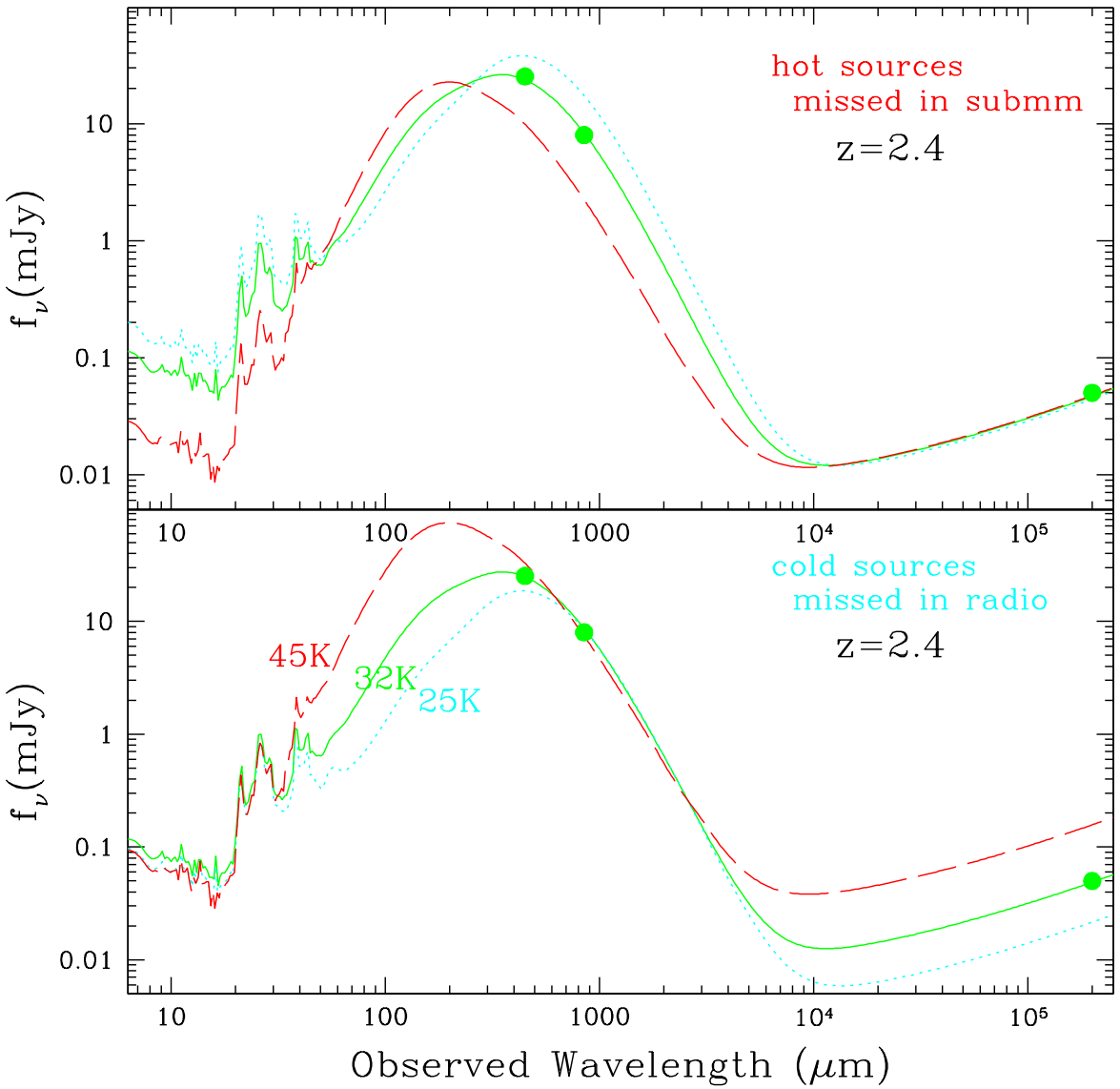
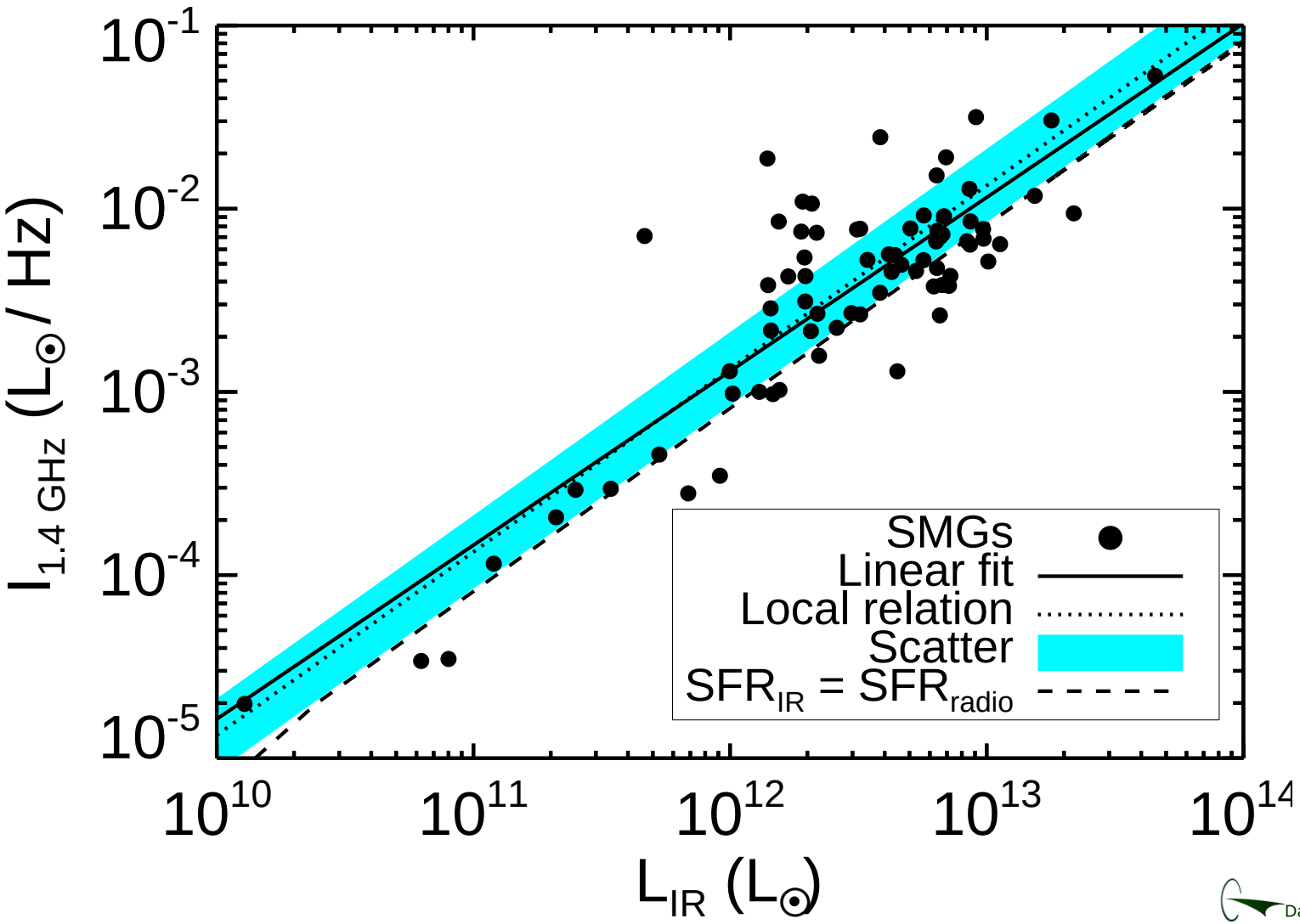
Selection effects (Chapman et al., 2005, ApJ, 622, 772)



FIR-Radio Correlation of SMGs



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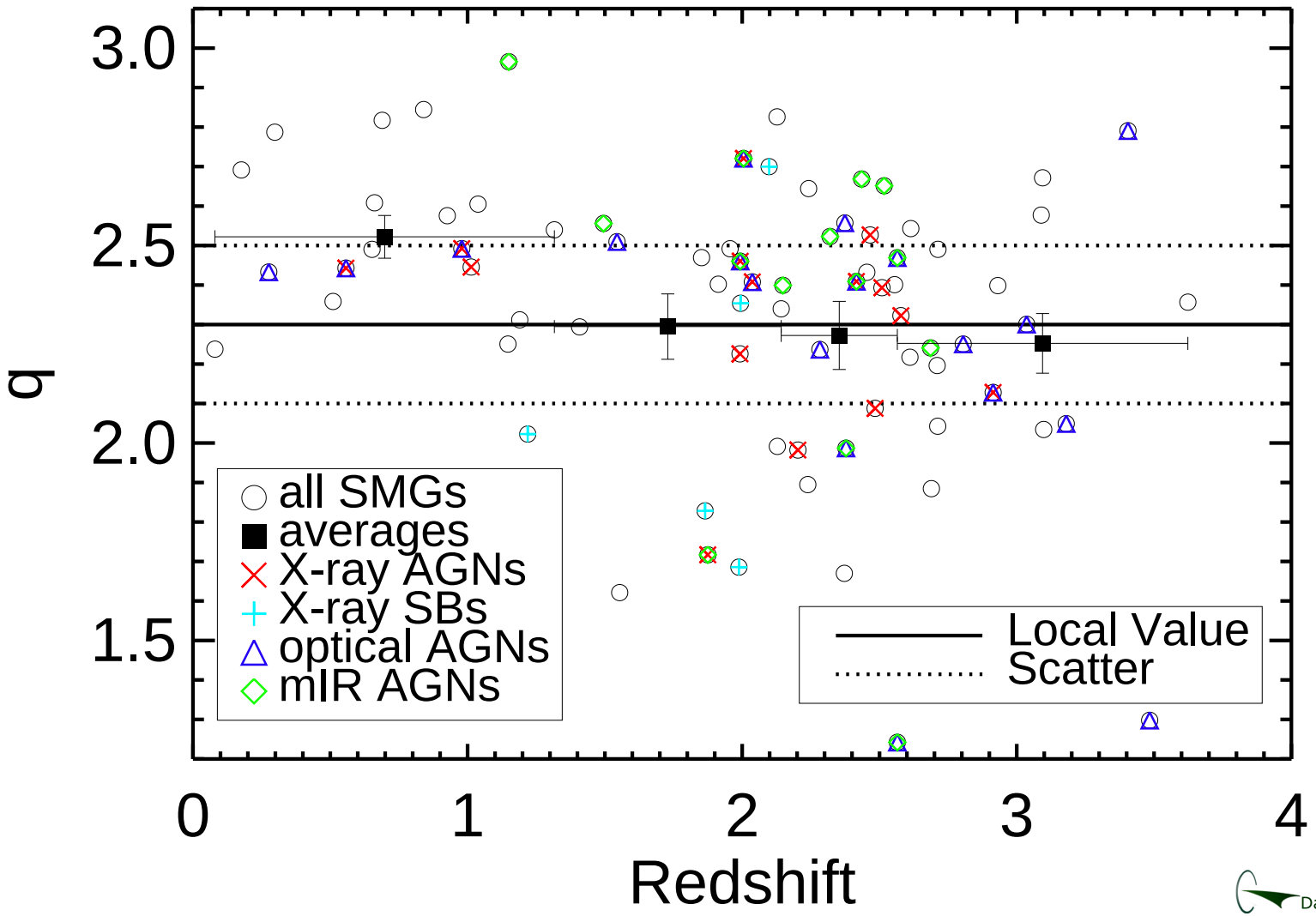

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Open questions

- SMG sample
  - Observations: Remaining 50% of the sample — different dust properties?
  - Theory: Selection effects — dust emission characteristics
- Emissivity index β
  - Observations: broader wavelength coverage to determine β
  - Theory: What does β tell us about dust properties?
  - Theory: β of silicate and graphite grains, influence of β on T_d and M_d
- Formation of dust and stars
  - Theory: timescales of star and dust formation (50 Myr?)
  - Theory: dust destruction? (massive SMGs have less dust per unit stellar mass)